CHAPTER 2. DESCRIPTION OF ALTERNATIVES

2.1 Alternative Development Process

This EA analyses two alternatives: Alternative 1 – Proposed Action; and Alternative 2 – No Action. The range of alternatives available to the planning team was limited due to the very specific purpose and need of the project. The planning team considered other treatment options (See Section 2.4) but dismissed these options because they did not fully meet the purpose and need of the project. The action alternative described (Alternative 1) is the only reasonable treatment option available that would achieve the purpose and need, and best meet the goals and objectives of the project.

The actions described in these alternatives were developed based on studies about Redwood Creek and the Redwood Creek Watershed and site-specific data. Designs and hydrological and geomorphological analyses of these designs were prepared by Kamman Hydrology and Engineering (KHE, 2006). Other studies used to develop and analyze actions are as follows:

Geomorophic/Hydrological Analyses. An evaluation of historic conditions compared to existing conditions and opportunities for restoration was conducted to evaluate the feasibility of restoration actions (PWA 2000). An assessment of watershed conditions was conducted to evaluate management and data needs of Redwood Creek (Stillwater, 2006).

Sediment Budget Analyses. An evaluation historic and current quantities of sediment as well as likely sources of sediment was conducted (Stillwater 2004, 2005a).

Wetland Maps. Wetlands that are under the regulatory jurisdiction of the U.S. Army Corps of Engineers were mapped by NPS and certified by the ACOE in 2003 for the 28-acre main field (Castellini and Shoulders, 2003). Proposed jurisdictional wetlands in the Old Ballfield were mapped by NPS in 2006 (Castellini and Shoulders, 2006). Wetlands were mapped using the Cowardin classification system in both 2003 and 2006 (Cowardin et al, 1979).

Vegetation Surveys. Surveys for rare plants were conducted by NPS in 2002 and 2003 (Faden, 2002, Taylor 2003).

Topography Surveys. One-foot contours of the entire project area were mapped in 1999 by Towill, using aerial photogrammetry. Additional cross-sections, channel profiles, and spot elevations on roads and similar features collected between 2002 and 2006 supplemented this data (Towill 1999, Environmental Data Solutions 2006, UC-Berkeley, 2005, KHE, 2006).

Historic Resources Survey. A Determination of Eligibility was conducted of the site to determine if it qualifies for listing in the National Register of Historic Places (Weeks and McKee, 2006).

Archeological Survey. In September 2006, NPS conducted a subsurface investigation in the main field at the base of alluvial fans to determine whether archeological resources occur in areas considered likely "hot spots."

Salmonid Surveys, 1998-2006. Both NPS and academic researchers have conducted spawning surveys, habitat surveys, and assessments of juvenile populations in Redwood Creek (Reichmuth et al, 2006; Smith, 1994-2001).

Songbird Surveys, 1999-2001. Ornithologists with the Point Reyes Bird Observatory have conducted multiple years of surveys on songbird nesting and vegetation use in the Redwood Creek Watershed. The data provides specific information about vegetation

species and structural patterns desired for songbird habitat (Gardali et al, 1999; Scoggin et al, 2000; Gardali et al, 2001).

Reference Reach Comparison. Kamman Hydrology and Engineering collected creek morphology data both on-site and in a more natural reach of the creek through State Parks lands to develop design details (KHE, 2006).

Site Reconnaisance and Personal Interviews. Kamman Hydrology and Engineering conducted multiple site reconnaissance surveys to observe flow patterns and topographic features related to flooding near Muir Woods Road and Highway 1 and to evaluate other site features. Interviews were conducted with local residents familiar with prior agricultural actions.

2.3 Alternatives Considered in Detail

Alternative 1 (Preferred)

Alternative 1 consists of the suite of actions described below. Actions and locations are shown on Figure 4. Detailed designs of proposed actions are shown in Appendices A and B.

Actions on the Old Ballfield

Floodplain Reconnection: A 970-foot-long levee on the left bank (when facing downstream) of Redwood Creek adjacent to the "old Ballfield" will be removed to allow average winter creek flows to spill onto the natural floodplain at the ballfield. The levee ranges from two to six feet high, with an average height of about three feet. It will be excavated to a grade matching the elevation of the adjacent field. Existing stands of the highly invasive non-native Cape ivy (*Delaria odorata*) on and adjacent to the levee over about a 1.3-acre area will also be removed and hauled away from the site. The newly exposed ground surface will be revegetated with native riparian species (Appendix C). A new 930-foot-long set-back levee will be constructed closer to Muir Woods Road and Highway 1 to prevent new overbank flows from flowing onto those roads. The setback levee will be six feet wide at the top, with 3:1 side slopes. It will average about 3 feet high and tie into the 27-foot elevation on Muir Woods Road. The 40-foot-long portion of the existing levee closest to Highway 1, currently at only 23.5 feet high, will be raised to 25 ft, provided a Caltrans right-of-way encroachment permit can be obtained. The sides of the levee will be actively revegetated with native scrub species, such as Coyote brush (*Baccharis pilularis*) to reduce long-term weed establishment. This new setback levee is proposed as a component of a future new trail alignment for the Coastal Trail, described in Cumulative Impacts in Section 3.2.

Floodplain Microtopography Enhancement: The currently flat field will be recontoured slightly to create micro-topographic conditions that will guide high flows and help fish on the floodplain find routes back to the creek as flows subside. Broad low-relief "channels," about 20 to 40 feet wide, will be graded about a foot deeper than the existing grade to guide high flows. Excavated material will be placed as small mounds on the adjacent surface to enhance the topographic variation. Large wood will also be placed at scattered locations on the ballfield to create refugia and diversity. An existing stand of the invasive non-native grass tall fescue (*Festuca arundinacea*) covering about 1.5 acres will be

FIGURE 2. EXISTING SITE CONDITIONS

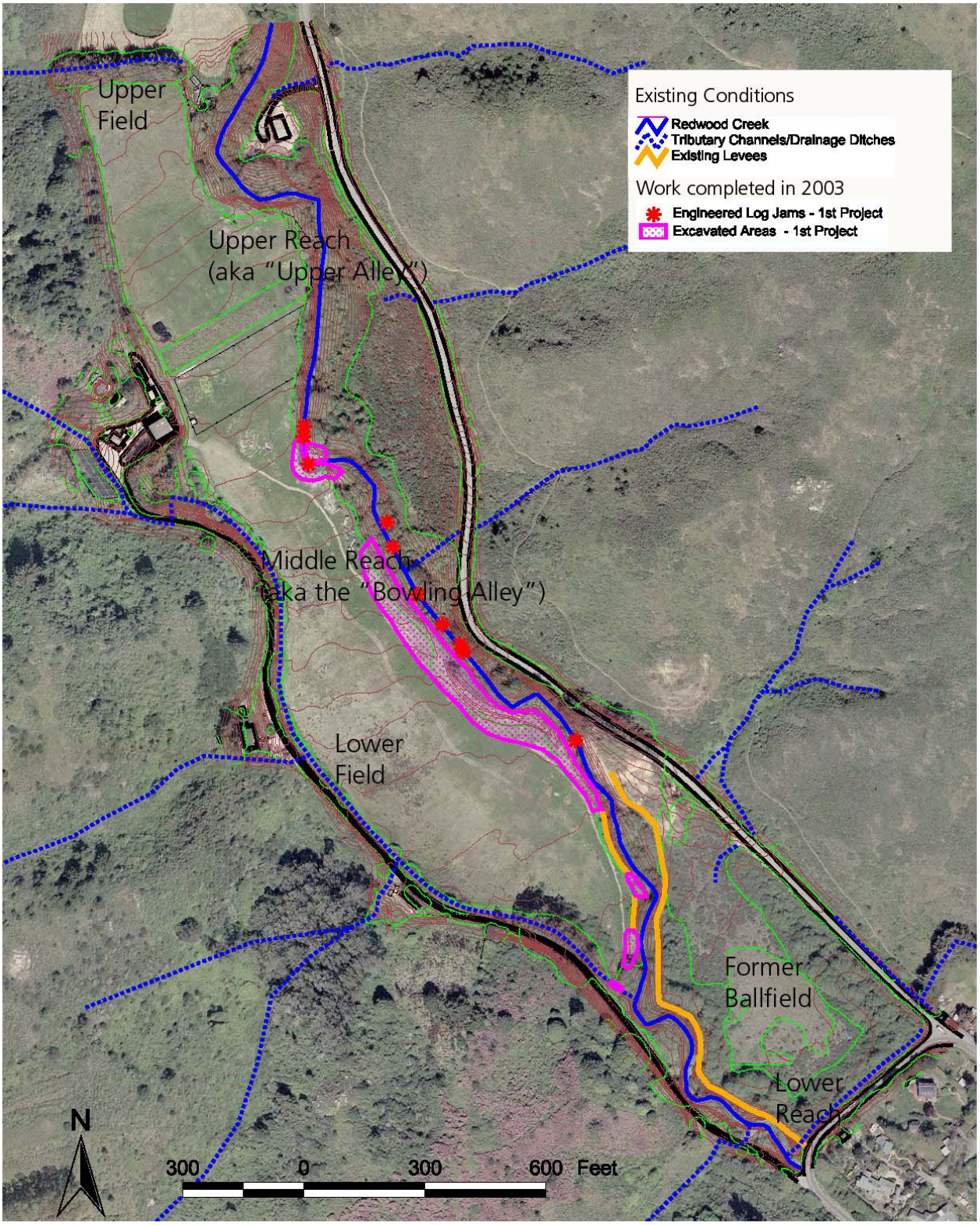
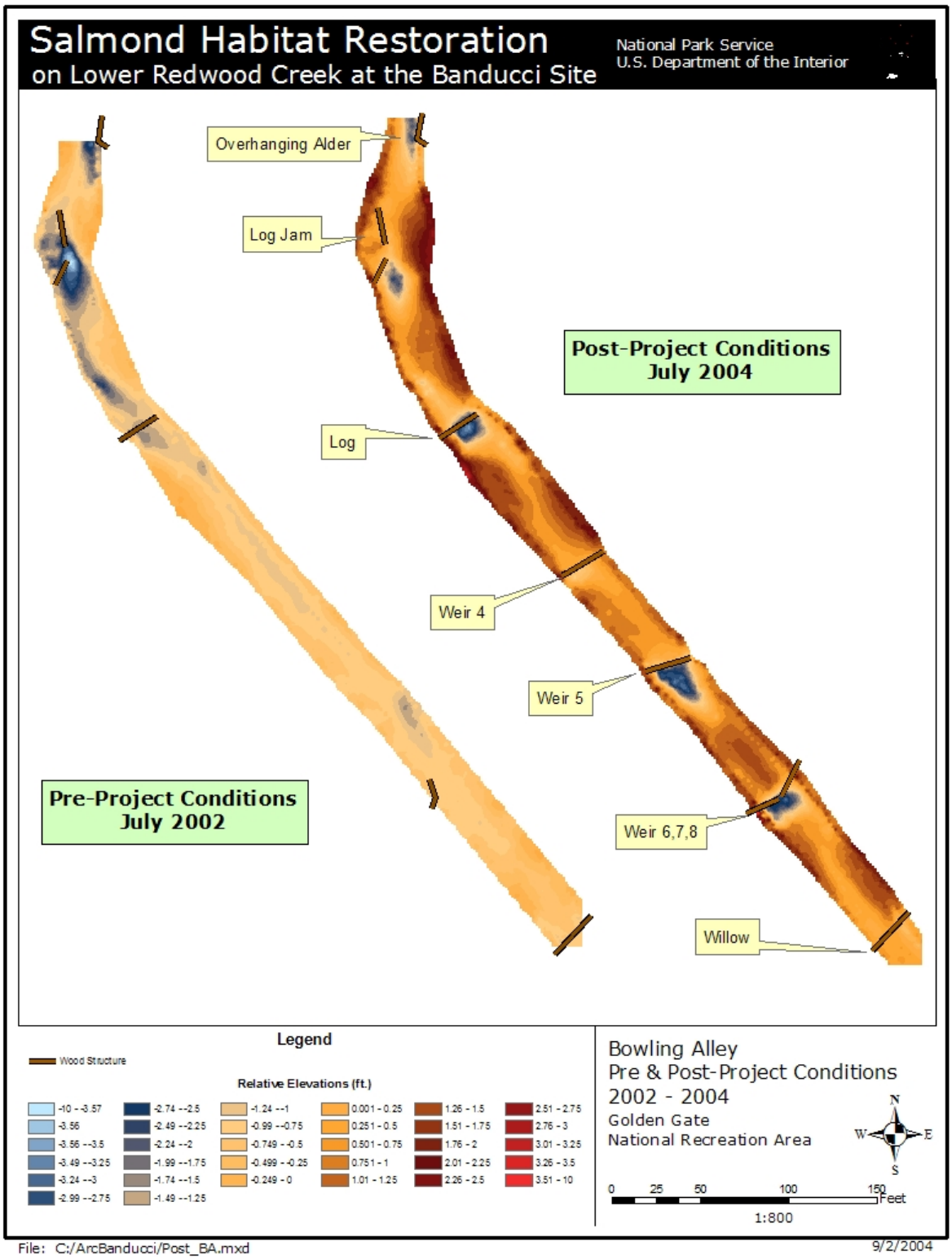


FIGURE 3. CHANNEL MORPHOLOGY BEFORE AND AFTER 2003 RESTORATION ACTIONS (COLOR VARIATIONS SHOW GRADE VARIATIONS)



scraped, placed in an on-site pile, and covered to compost over time. Revegetation in this area will consist of a combination of planting berry-producing riparian plants favored by songbirds and some reliance on natural recruitment processes to recreate the riparian habitat that would naturally occur on this site (Appendix C).

Actions in the Lower Field

Levee Removal: Two short remnant lengths of levee (150 and 85 linear feet) on the right bank of the creek at the lower (south) end of the main field will be removed. The combined area of these two small levees is about 0.12 acres, about half of which are covered with riparian vegetation. They will be removed to create additional area where high flows on the lower field can re-enter Redwood Creek. In addition, their removal will allow for an optimum location of newly created "high flow" paths on the field. The areas where levees will be removed will be replanted with native riparian vegetation.

Floodplain Microtopography Enhancements: A network of about four low-relief, high-flow channels will be excavated over some about 10 acres of the lower field to enhance the movement of high flows onto and off the floodplain and provide salmonids with routes back to the creek as floodwaters recede. The relief channels will be broad – about 20 to 40 feet wide, and about 1 to 1.5-feet deep at a maximum. The microtopography will provide a subtle change to the appearance of the field that will sustain a new diversity of vegetation over time. Edges of the high flow channels will be planted with native willows at broad intervals to provide plant diversity and enable high flows to scour against the tree trunks. Fill excavated to create the relief will be placed as low linear mounds on the field, adding to the new topographic diversity on the site. Large wood will also be placed throughout the lower field for the same purpose.

Expansion of Lower Drainage: The existing drainage ditch on the west side of the field will be widened by about 20 feet along approximately 150 linear feet of the ditch closest to its confluence with Redwood Creek. This will expand the winter habitat available to juvenile salmonids, where they can escape the effect of high winter flows in the creek.

Drainage Enhancements: The natural hydrological connection between two hillside drainages and the lower field will be enhanced by replacing existing culverts under the access road with larger culverts or drainage grates and by filling three segments of a ditch adjacent to the gravel access road on the site. Each segment to be filled will be about 9 feet by 20 feet, and this will encourage runoff from flowing out into the field, as it would have occurred before the ditches were constructed. The whole ditch will not be filled to avoid losing wetland area. The more natural flow pattern out to the field will be enhanced by the new high flow channels on the Lower Field.

Construction of Berms around New Red-Legged Frog Ponds: As part of a separate project, a new 1.2 acre pond will be constructed in the lower field to provide sustainable breeding habitat for the California red-legged frog. This action is described in Section 3.2, Cumulative Impacts. As part of project actions in this EA, fill material will be placed in a low 1.5-foot berm around the edge of the pond to reduce likely sedimentation from

overbank flows and prevent fish entrapment in most flood events. The berm will protect the ponds from overbank flows in up to a 10-year flow event. The location of the ponds already receives overbank flows due to floodplain restoration actions conducted in 2003. Approximately 640 cubic yards of material will be used to build these low berms. One or two logs will be placed in the pond to provide areas for frogs to sit in the sun. Willows to be planted around the edges will eventually hide the berms from view.

In-Channel and Floodplain Actions in "Upper Alley"

Installation of Engineered Log Jams: Seven engineered log jams (ELJ's) will be installed in the 580-foot-long reach of the Upper Alley. Six ELJ's will be deflector jams specifically designed to reduce the width of the low flow channel from 20 feet to about 7.5 feet wide, thereby increasing summer habitat for salmonids because the low flow channel will also be deeper. Each deflector jam consists of four logs - two large crossed logs extending from the bank into the channel with two smaller logs inserted vertically on either side of the crossed logs. Of the two crossed logs, a lower log points upstream at a low angle and acts as a weir to direct the flow away from the bank. The upper log acts as an "anchor" log to help secure the weir log in place. The upper log extends into the creek at a 90 degree angle. The pinning logs are installed almost vertically into the bed on either side of the structure to provide additional ballast and stability. The log structures will not span the entire channel, but will extend a maximum of ½ to ¾ of the width of the active channel. Log structures will be spaced approximately four to five channel widths apart. The seventh ELJ will consist of reconfiguring an ELJ installed in 2003 at the downstream end of the Upper Alley to direct flows toward the left side of channel, away from the former eroded bank on the right side of the channel.

Channel and Floodplain Widening: The floodplain in the Upper Alley will be widened along about 580 linear feet of channel to create a minimum 80 foot-wide floodplain. The active channel will be widened by about 10 feet in two small reaches about 75 feet long, but will not be conducted in other locations in order to retain trees and encourage development of undercut banks at the base of tree roots, thereby creating habitat for salmonids (Figure 4 and Appendices A and B). These actions are based on data showing that both the active channel and floodplain widths of the Upper Alley are significantly undersized compared to a reference reach – an upstream reach of the channel that appears to have already recovered natural dimensions. Excavation, or terracing into the existing high walls of the creek bank, will be conducted on both the left and right banks in order to minimize the amount of fill that must be removed to achieve more natural widths. The right bank excavation will be tied into the excavation conducted at a formerly eroded bank at the upstream end of actions taken in 2003. About 2,185 CY of fill will be excavated. As part of the excavation, three old cars on the bank that once functioned to stabilize the bank during the past agricultural use will be removed and disposed of offsite. The area will be revegetated with native riparian plant species.

Utility Pole Relocation: One PG&E utility pole will be relocated. It supports only wires for electricity and is located occurs on the right (west) bank at the downstream end of the Upper Alley. It is currently very close to the top of the channel bank and would be

eventually undermined if it is not relocated. Its relocation allows for excavation on the right bank at that location.

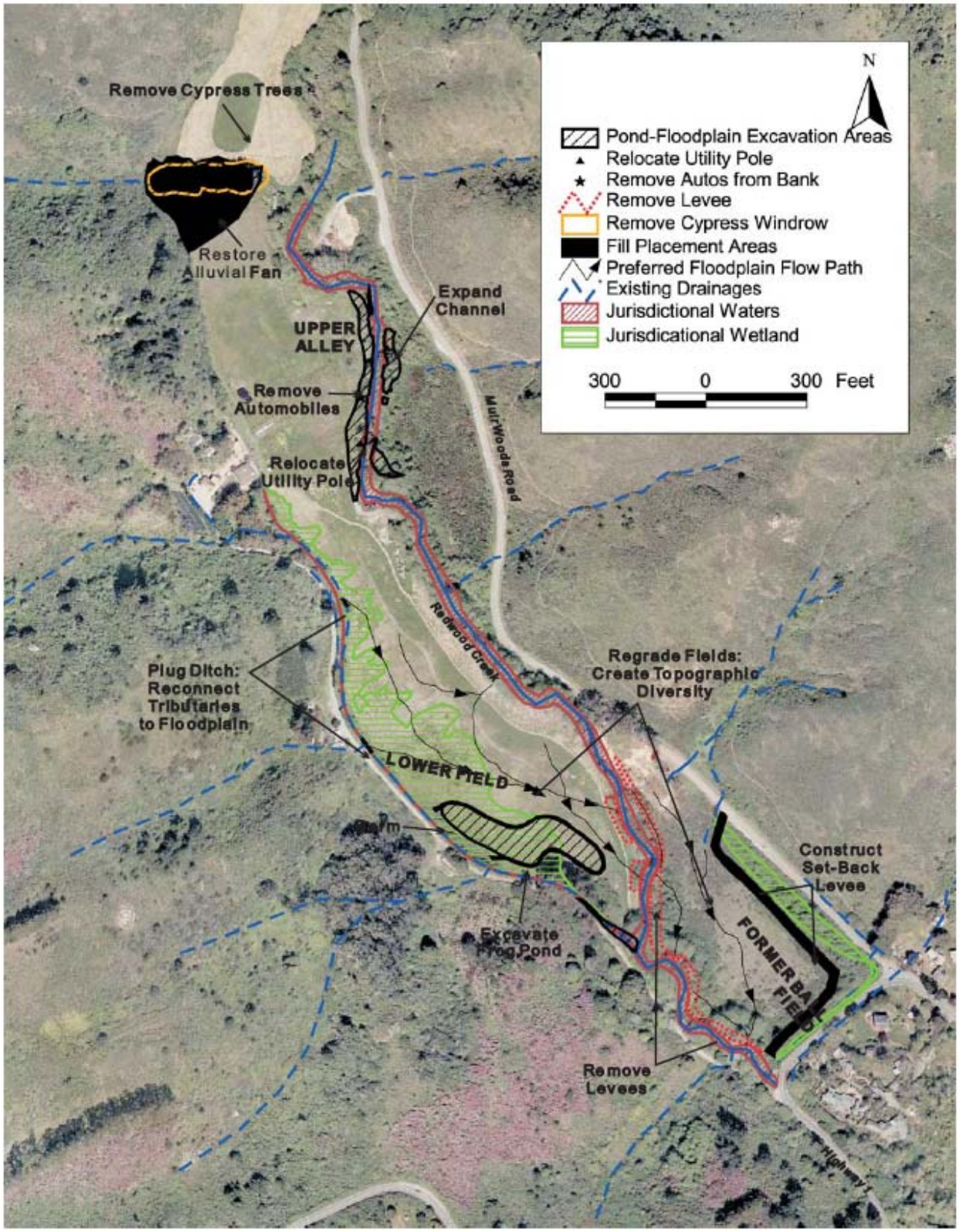
Well Abandonment: A concrete well-head box on the right (west) bank at the downstream end of the Upper Alley will be removed. The well is no longer active, but the concrete casing occurs at a location which is subject to bank erosion. To meet state requirements for proper well abandonment and to avoid the possible loss of concrete materials into the creek, the casing will be removed and disposed of, and the area will be backfilled. This action may take place at a separate time following other project actions.

Actions in Upper Field

Rebuild Alluvial Fan at Drainage/Cypress Windrow: At the northern boundary of the site, there is a substantial grade difference of up to about 5 feet between the NPS property to the south and the California State Parks property to the north. This presents the opportunity to use excavated soil to rebuild a natural contour on that location. An ephemeral drainage (flowing only during wet months) from the hills to the west flows through that area and once would have flowed over a more gradual sloping "fan," or alluvial fan. The "fan" will be rebuilt using about 4,300 cubic yards of fill excavated for other project actions. The new contour will slope gently from the base of the hill at the western edge of the site and will be tied into the grade of the adjoining State Parks property. The newly contoured "fan" will extend over a total of 1.3 acres. All fill placement would take place on NPS property. Drainage patterns currently route about a third of the drainage to the north of the trees and the rest to the south. Drainage to each side is expected to remain about the same after project implementation; but immediately after construction, short-term erosion control actions will be taken to encourage flow to spread rather than to create a drainage ditch through the fan. About six small-diameter Eucalyptus trees on the adjacent hillside will be removed as part of this action. The newly placed fill will be revegetated with native coastal scrub species (Appendix C).

Removal of Monterey Cypress Trees in the Windrow: Some of the Monterey cypress trees in a windrow marking the northern boundary of the Banducci site will be removed for use in the Engineered Log Jams in the Upper Alley. Out of about 48 total trees in the windrow, approximately 28 trees would be toppled, with the rootwads attached. It is possible that some immediately adjacent trees would also be uprooted by the toppling and would therefore also be removed, increasing the total number of trees to be removed to more than 28. Trees are expected to be removed in groups, creating small "windows" through the row of trees. Limbs from the cut trees would be removed and placed in a slash pile for later burning during the appropriate season. Limbs growing close to the ground on trees that will not be removed may also need to be cut to allow for grading activities on the new alluvial fan. The toppled trees would be used as Engineered Log Jams in the Upper Alley. Other trees that are felled because they are close to the needed trees may be placed on the Lower Field as part of the creation of structural and topographic diversity in that area. The tree removal will also facilitate better integration of the new alluvial fan with the existing grade on State Parks property.

FIGURE 4. PROPOSED ACTIONS



Fill Placement

Soil excavated for project actions will be reused on site for beneficial actions. The reconstruction of a set-back levee, the rebuilding of the alluvial fan at the north end of the field, the creation of small linear mounds on the lower field, and the construction of a small berm around the newly constructed frog pond are expected to use all of the fill material generated during excavation. Any fill in excess of what is needed for the beneficial uses/ restoration actions may be stored temporarily for subsequent reuse in the NPS proposed project to recontour the Dias Ridge Trail. Other materials expected to be disposed of off site include non-organic materials, such as the old cars to be removed from the channel bank, and soils heavily infested with noxious invasive plant material, such as cape ivy.

Revegetation

Following grading activities by heavy equipment, NPS and the Parks Conservancy will conduct active revegetation, erosion control and non-native plant management to reach project goals for enhanced floodplain habitat. Revegetation goals and strategies for the four action areas of the site have been developed by the Parks Conservancy nursery management staff and NPS vegetation ecologists, with input from Point Reyes Bird Observatory Conservation Science ornithologists (Gardali, pers. comm., 2006). Revegetation goals, strategies, timelines, native plant palettes, and vegetation types for each action area are shown in Appendix C. Most of the revegetation activities will be accomplished through the participation of park volunteers, school groups, and conservation crews.

Alternative 2 (No Action)

Alternative 2 is the No Action Alternative. Under this scenario, the creekside levee adjacent to the ballfield would not be removed and would be left to naturally break down over time. Neither floodplain functions for salmonids nor floodplain storage would be enhanced until the berm naturally broke down. In the lower field, the right bank levees would remain in place, the flat, leveled grade of the field would remain as is, there would be no new berms constructed adjacent to the new frog pond, and the drainage from the hillsides would continue to be routed to the drainage ditch. In the Upper Alley, no excavation or Large Woody Debris (LWD) installation would be conducted. The Upper Alley would be left to transition through natural processes to a wider active channel, narrower low-flow channel, and wider floodplain. The transition would entail erosion of significant quantities of sediment as the new floodplain and wider channel is cut by high flows.

2.3.1 Comparison of Impacts and Benefits of Alternatives

Alternative 1 actions would provide a suite of benefits for natural creek processes and salmonid habitat, whereas the No Action alternative would cause the creek in the project area to persist with its constrained floodplain processes, eventual erosion of overly narrowed channel widths, and inadequate rearing habitat for salmonids. Alternative 1 actions will integrate the entire floodplain of the Lower Field with both the creek on the east and the hills and drainages to the west, restoring an integrated landscape and inviting long-term re-establishment of native vegetation and structural diversity to a broad 10 to 12-acre area. By contrast, the No Action

alternative would not alter the Lower Field, remain as a flat, grass-dominated field. Alternative 1 will improve winter salmonid habitat through the widening of the lower end of the drainage ditch and by creating create high flow paths on the floodplain that allow salmonids to find their way back to the creek more effectively and also provide more structural diversity for the floodplain, whereas the No Action alternative would leave the field with a sheet flow during high flow events that is not as effective for salmonid refugia. Alternative 1 would improve the summer rearing habitat in the Upper Alley by creating a deeper, narrower low flow channel that provides better habitat, whereas the No Action alternative would probably entail a long-term erosional process to create similar conditions. Similarly, Alternative 1 will reduce sediment inputs to the creek while increasing available floodplain areas for sediment deposition, helping to restore a more natural equilibrium to sediment dynamics in a watershed where current sediment production is known to be higher than levels during historic undisturbed periods. The No Action alternative would not improve sediment dynamics, and, in fact, would lead to further elevated contributions of sediment by failing to remove the over-narrowed banks that would eventually erode to achieve natural channel widths.

Alternative 1 would expand floodplain function and floodplain storage on the Old Ballfield, both enhancing habitat and reducing peak flows downstream of the project area; whereas the No Action alternative would leave such benefits to the long-term process of eroding the berms. Alternative 1 would have short-term adverse impacts during construction implementation to the creek flow, turbidity, and fish (due to their relocation away from the construction zone), as well as short term minor adverse impacts to traffic on Muir Woods Road. The No Action alternative would not have such construction-related impacts, but would fail to provide benefits.

2.4 Actions Considered but Rejected

Old Ballfield

The only possible alternative approach to reconnecting the creek with its historic floodplain on the old ballfield would be to remove only a short segment or multiple short segments of the creekside levee, instead of removing all of it. However, partial removal would be considered a design refinement, not a substantial difference that would describe an alternative. Even as a design refinement, partial removal was not considered further because total removal achieves the full purpose of both floodplain connection and allowing easy routes for fish to reenter the creek. These design refinements, if incorporated, would not cause additional impacts.

Upper Alley

A series of design approaches were considered to achieve goals for natural creek processes and enhanced salmonid habitat in the Upper Alley. Several possible widths for floodplain terracing were considered for the incised reach of the Upper Alley, but only one was analyzed as an alternative. Terracing can be conducted on the steep, vertical banks in the Upper Alley to create an active floodplain width of distances ranging from 30 to 100 feet. The possible floodplain widths are not considered alternatives, but possible refinements of the design and are therefore not analyzed in this document as alternatives. The proposed approach to widen the floodplain up to 80 feet wide was based on a reasonable approach that would meet project goals, with a cost-effective quantity of fill to be relocated for this purpose. Finally, details such as construction of alcoves do not represent alternatives, but are details of a design approach.